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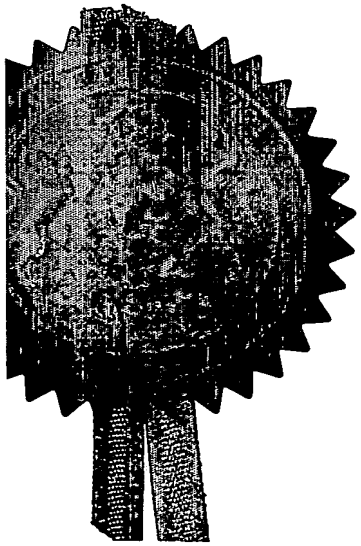

Signed

Dated 1 May 2003

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
18 APR 2002

The Patent Office

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

19APR02 E712175-3 D00178
P01/7700 0.00-0208881.3

The Patent Office
Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference

NG/20682

2. Patent application number
(The Patent Office will fill in this part)

0208881.3

18 APR 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

TRANSENSE TECHNOLOGIES PLC

66 Heyford Park
Upper Heyford
Bicester
Oxon. OX25 5HD
GB

Patents ADP number *(if you know it)*

7253404004

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Improved Method for Tracking a Resonant Frequency

5. Name of your agent *(if you have one)*

A A THORNTON & CO

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

235 HIGH HOLBORN
LONDON WC1V 7LE

Patents ADP number *(if you know it)*

0000075001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

NO

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	2
Claim(s)	-
Abstract	-
Drawing(s)	1 + 1

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature A A Thornton + Co Date 18/04/02

12. Name and daytime telephone number of person to contact in the United Kingdom

NIGEL GOODENOUGH - 01604 638242

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

Improved method for tracking a resonant frequency

The method described shows an improvement to that already described within WO98/21818 for tracking a resonant frequency. There are two main benefits to the approach described. Firstly multiple resonant structures can be connected together and interrogated through a single channel. Secondly it is not required that a directional coupler be used.

The use of a single channel can give significant benefits when the strategy is used for the preferred system of non-contacting torque measurement using SAW (surface acoustic wave) devices as the sensing elements. Current systems use two SAW devices attached to a rotating shaft in such a way that when torque is applied one resonator is put in tension whilst the second is put in compression. This causes the resonant frequency of the first device to reduce whilst the second will increase. The two devices would normally have a nominal difference between them of 1MHz, such that with torque the output from the system is a difference frequency that changes about 1MHz with applied torque. The two sensors on the shaft are electrically connected to the stator of the assembly via two pairs of non-contacting rotary coupled transmission lines. The use of two pairs of couples has the disadvantage that the size and complexity of the mechanical assembly is increased, and thereby the cost. In addition the rotary coupled transmission line can load the SAW resonator and thereby modify its frequency. As the system is a differential one if both couples modify there respective sensor response by the same amount then this effect can be cancelled out, however if the two channels are not identical then an error can result. If the interrogation signals can be passed through the same transmission path then the effect on each signal will be the same.

A simplified schematic of the system is shown in figure 1. If we assume that the signal source is a high frequency oscillator with a centre frequency within the bandwidth of the resonator and that it is also frequency modulated again with a deviation that is within the bandwidth of the resonator. As the impedance of the SAW changes rapidly with frequency around its resonant point then the amplitude of the signal seen after the resistor in figure 1 will also vary as the frequency is modulated. Because the output impedance of the signal source is very low this amplitude modulation will not be seen here. So if both these signals are passed to a mixer and then to a low pass filter to remove the sum products all that will remain is the amplitude modulation component of the signal. This demodulated signal can then be used within a control loop to track the resonant frequency of the SAW device.

Figure 2 shows how SAW devices can be connected together and interrogated through a single channel. Two synchronous detectors are then used to separate responses of the two sensors. Because the SAW devices have a nominal difference frequency of 1MHz and because the amplitude modulation caused by each SAW device will be at 5kHz with the 2^{nd} harmonics at 10kHz the modulation caused by each SAW device can be separated within the electronics allowing each SAW resonance to be tracked individually. For example when the 200MHz FM signal is mixed with the composite 200 and 201 MHz FM signal with amplitude modulation the difference product will be the 5kHz signal generated by the modulation due to the 200 MHz SAW, the modulation cause by the 201 MHz device will be offset by 1 MHz and can therefore be easily filtered out.

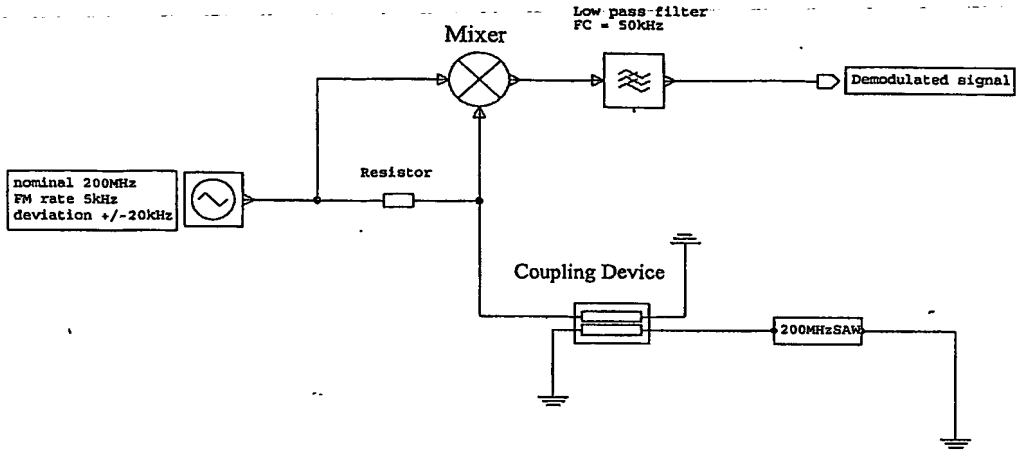

Figure 1. simplified schematic of system

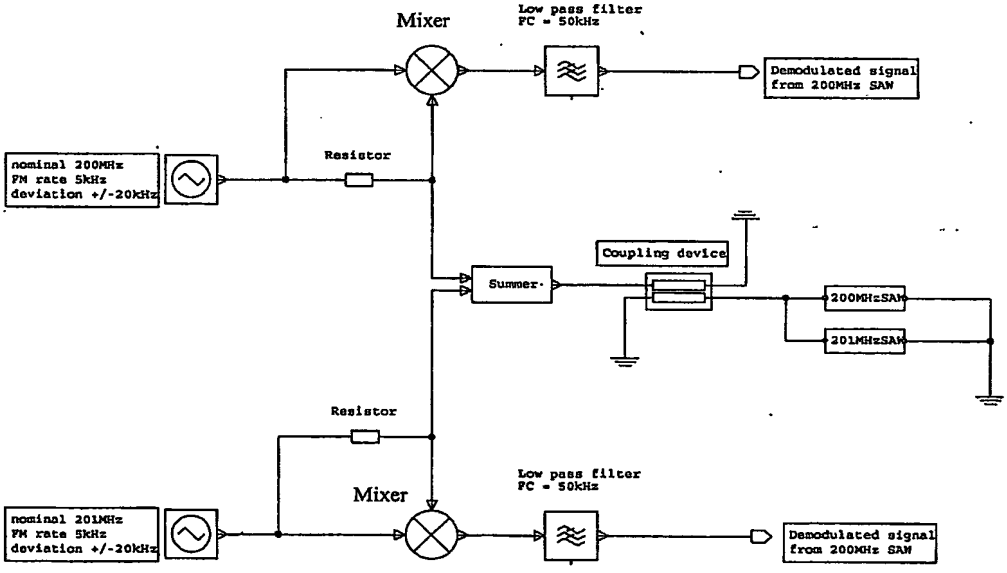

Figure 2. simplified schematic of system containing two SAW